Finally we come to the "machines a explosion," or balloons propelled by gas engines. Paul Haenlein in 1865 was the pioneer of this type, although he seems to have had no practical success. The German machines of Woelfert, Schwartz, and the first Zeppelin are in turn described, though each of them proved failures. The various vessels of Santos Dumont next claim attention, especially his much-lauded trip round the Eiffel Tower. More failures and catastrophes followed with Rose, Severo, and De Bradsky, and then came the successful essays of the Lebaudys. The history of this type of airship is fully gone into, from the first trials up to the unfortunate escape of the *Patrie*.

Then follow descriptions of the other French dirigibles, the *Ville de Paris*, and that of Count de la Vaulx.

The modern airships of other countries are disposed of in a few pages. The Zeppelin No. 3 is shortly described, but its better-known successor, which has since made its *début* and taken its *congé*, is referred to in the final pages of the book. Having described the Polar explorations by balloon at some length, the authors give a chapter on aëroplanes. The latter can hardly be called up to date, since progress has been so rapid during the last year or two. It is almost amusing to read of M. Farman's record performance of remaining in the air for 52⅗ seconds when to-day we think nothing of Mr. Wright flying for more than an hour with a passenger. In these circumstances of kaleidoscopic changes it seems impossible to bring out a book on aëronautics which shall be really up-to-date, but the one before us is a good little history which is fairly trustworthy, though it is not detailed enough to be classed as a technical text-book.

An English Holiday with Car and Camera. By James John Hissey. Pp. xviii+426; with 28 full-page illustrations and a map of the route. (London: Macmillan and Co., Ltd., 1908.) Price 10*s*. net.

IT was scarcely necessary for Mr. Hissey to tell us, as he does in his preface, that he travels purely for pleasure and "in search of the picturesque." Those readers who know the author's many pleasant, gossipy books about English by-ways have long been aware, from the optimistic way in which rural England is described, that Mr. Hissey loves exploring his native land. This time the journey taken by the author and his wife was confined to motoring in the country south of a line joining the Wash to the Bristol Channel. The account of the wanderings, with its many glimpses of the home-life of the country people, and the excellent illustrations, combine to make a very interesting volume.

Pearls and Parasites. By A. E. Shipley, F.R.S. Pp. xv+232; with illustrations. (London: John Murray, 1908.) Price 7*s*. 6*d*. net.

THE title of Mr. Shipley's book scarcely serves to indicate the general character of the contents. The volume contains nine essays, which, with one exception, deal with problems of economic zoology. The subjects introduced vary considerably among themselves, as the following titles show:—Pearls and Parasites; the Depths of the Sea; British Sea-fisheries; Zebras, Horses, and Hybrids; Pasteur; Malaria; "Infinite Torment of Flies"; and the Danger of Flies. The concluding essay is an inquiry into the aims and finance of Cambridge University. Most of the essays have appeared previously in periodicals, and have been read by many people interested in science. The subjects discussed are sufficiently important to attract the scientific as well as the general reader.

Architectural Education. By Wilfrid I. Travers. Pp. vii+119. (London: Harrison, Jehring and Co., 1908.) Price 4*s*. net.

THE subtitle of this book indicates its character with fair precision; it runs:—"A history of the past and some criticisms of the present system, upon which are founded some suggestions for the future, with particular reference to the position of the universities." Mr. Travers has collected much information as to the courses of training for architects and the syllabuses of the examinations conducted by the Royal Institute of British Architects and many universities, and also offers useful suggestions for their improvement. Many of the schemes of work here tabulated appear to give little prominence to the training in the principles of science which are necessary for an architect to ensure successful work.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Suggested Explanation of the High Velocities of Gases observed on the Solar Surface.

THE important discovery by Prof. Hale of the Zeeman effect in sun-spot spectra proves the presence of extensive areas on the solar surface in which ions of one kind largely preponderate. This suggests the solution of one great difficulty which has blocked the way in the attempts that have been made to explain the very high velocities which are not unfrequently observed near the solar surface by spectroscopic and other means. For there is a limit to the velocity of a gas impelled by pressure only, this being the velocity with which it streams from a high pressure into a vacuum, and we may put this limiting velocity to be equal to that of propagation of sound in the gas. Observation shows that the highest velocities observed on the solar surface are about 200 times as great as the velocity of sound in hydrogen at the temperature of freezing water.

If, then, these masses of moving matter are impelled by pressure only, the number expressing their absolute temperature divided by the density must be 40,000 times greater than the corresponding number in the case of hydrogen at 0° C. Taking the absolute temperature of the sun to be forty times as great as that of freezing water (which cannot be far from the truth), the observed velocities would become consistent with our supposition of pressure-motion only if the density of the gas were a thousand times less than that of hydrogen. This brings us down to the mass of the negative electron. As, however, spectroscopic evidence indicates the motion of ponderable matter (principally, if not solely, composed of hydrogen), we must assume that gases are entangled in the rush of electrons, but not to a sufficient degree to alter the average density materially. In the case of matter in which one kind of electrons preponderate, electric forces may, of course, increase the velocities almost to any extent, but the close agreement of the observed high velocities with the limiting velocity in a gas, having a density equal to the thousandth part of that of hydrogen, and being at a temperature agreeing, so far as we can tell, with that of the solar surface, is highly suggestive. I conclude, therefore, that if the observed velocities are real —and there is good ground for believing them to be so— the prominences and other appearances in which velocities of more than about 10 kilometres a second are observed are composed to a preponderating extent of electrons in which gases are entangled to a sufficient degree to give the spectroscopic test, but not sufficiently to alter materially the average density.

In conclusion, I should like to urge a word of caution

with respect to the last paragraph of Prof. Zeeman's article on Prof. Hale's discovery. The magnetic forces indicated by the splitting up of the lines are not sufficient to produce any direct observable magnetic effect at the distance of the earth. ARTHUR SCHUSTER.

Simla, October 6.

The Magnetic Disturbances of September 29 and Aurora Borealis.

SOME details of an unusually bright aurora, seen at Omaha, U.S.A., on the night of September 28, local time, may be of interest to the readers of NATURE in connection with the three-hour magnetic disturbance recorded on our magnetograms between 4 a.m. and 7 a.m. of September 29, Greenwich time.

The details come from Father Rigge, S.J., director of the Creighton University Observatory, Omaha. The sky was perfectly clear throughout the night. The aurora "seemed to commence suddenly at 9.50 p.m.," September 28, local time, *i.e.* at 4.15 a.m., September 29, Greenwich time, when the unifilar magnet at Stonyhurst commenced a rapid westward movement up to 62′ of arc at 4.40 a.m., returning more slowly in three sudden steps backward at 5.5 a.m., 5.35 a.m., and 6 a.m., accompanied by minor rapid oscillations.

The aurora was watched for two hours, up to the local midnight, and during this time alternations of the scene were observed between brilliant streamers of various lengths and breadths from a well-defined arch, and a broken-up arch accompanied by drifting luminous patches as of fiery clouds. It would have been interesting to compare the times of these changes with the halting movements of the magnetic needle, but the time was recorded only of the first appearance of the *streamers,* the smaller lengths of which "seemed to come directly out of the ground," and the noted time agrees closely with that of a single break in the first long and rapid deflection of the needle—a short step-back followed by a rush forward to its greatest elongation. The aurora was again looked for at 5 a.m. of the following morning, when nothing was seen in the still unclouded sky.

It is therefore probable that the auroral display began and ended synchronously with this greater deflection of the needle.

The three-hour wave was, then, followed by the usual rapid oscillations consequent upon a magnetic storm until 2.50 p.m., September 29, G.M.T., when another and a greater storm broke out and lasted until 4.30 of the following morning. At Omaha aurora was again seen at 7.15 p.m., September 29, local time, but in a less favourable sky, which clouded over at 9.15, and showed only by the brightened clouds that the aurora was still active at 10 p.m., when the greater oscillations of the magnets were ending. WALTER SIDGREAVES, S.J.

Stonyhurst College Observatory, October 21.

A Method of Solving Algebraic Equations.

So far as I can ascertain, the method referred to is not known, at least in its complete form. It is a development of a method described by me in a previous paper ("Verb Functions, with Notes on the Solution of Equations by Operative Division," Proceedings of the Royal Irish Academy, vol. xxv., Sec. A, No. 3, April, 1905), which was reviewed in NATURE of April 25, 1905. I give it here as briefly as possible.

Take, for example, the equation used by Newton to illustrate his method of approximation, namely,

$$x^3-2x-5=0,$$

which has one real root, 2·09455. . . . Write the equation in the form $x^3=2x+5$. Select any real number, x_1; substitute it for x in the right-hand member of the equation, and then find x_2 from $x_2=\sqrt[3]{2x_1+5}$. Next substitute x_2 for x_1 in the right-hand side of the equation, and find the value of x_3, and so on. We thus have a series of numbers connected by the equation $x^3{}_{n+1}=2x_n+5$, and it will be found that whatever number we start with for x_1, x_n constantly approaches the value of the root. Thus, if we begin with 11, we have $x_1=11$, $x_2=3$, $x_3=2{\cdot}2240$, $x_4=2{\cdot}1140$, $x_5=2{\cdot}0975$, $x_6=2{\cdot}0949$, ... Or, commencing with -100, we obtain $x_1=-100$, $x_2=-5{\cdot}7989$, $x_3=-1{\cdot}8756$, $x_4=1{\cdot}0768$, $x_5=1{\cdot}9268$, $x_6=2{\cdot}0688$, $x_7=2{\cdot}0907$, $x_8=2{\cdot}0940$, ...

Again, take the equation $x^3-15x-4=0$, which has three real roots, 4 and $-2\pm\sqrt{3}$, that is, 4, $-0{\cdot}2678$, and $-3{\cdot}7321$. Write it in the form $x^3=15x+4$. and begin with any number above the limits of the positive roots, say 16. Substitute this for x in the right side of the equation, and proceed as before. Then $x_1=16$, $x_2=6{\cdot}2488$, $x_3=4{\cdot}6062$, $x_4=4{\cdot}0124$, $x_5=4{\cdot}0039$, ..., which is nearly the first root.

In order to obtain the next lower root take for x_1 a number which is a little less than the first root, say 3·9, and substitute it for x, *not* in the *right* side of the equation, but in the *left* side, so that now $\frac{x_1^3-4}{15}=x_2$. Thus we obtain $x_1=3{\cdot}9$, $x_2=3{\cdot}6880$, $x_3=3{\cdot}0558$, $x_4=1{\cdot}6356$, $x_5=0{\cdot}0351$, $x_6=-0{\cdot}2666$, $x_7=-0{\cdot}2679$, ..., which is nearly the second root.

For the third root take a number, say $-0{\cdot}3$, which is a little less (algebraically) than the second root, and substitute it for x in the *right* side of the equation, as done for the first root. We thus obtain $x_1=-0{\cdot}3$, $x_2=-0{\cdot}7937$, $x_3=-2{\cdot}0$, $x_4=-2{\cdot}9625$, $x_5=-3{\cdot}4313$, $x_6=-3{\cdot}6203$, $x_7=-3{\cdot}6910$, $x_8=-3{\cdot}7169$, $x_9=-3{\cdot}7267$, ..., which is nearly the third root.

We can solve the equation in the same manner by beginning with any number, say -5, which is below the limit of the negative roots, and substituting it for x in the right side of the equation; then after finding the lowest root, substitute a greater number for it in the left side of the equation, and so on. We may thus either descend from the highest to the lowest root, or ascend from the lowest to the highest. It is evident that a root is obtained when $x_{n+1}=x_n$, because the equation is then satisfied.

We took the original equations in the forms $x^3=2x+5$ and $x^3=15x+4$, but we may take them also in the forms $x^2=2+5/x$ and $x^2=15+4/x$, or in other forms obtained by ordinary algebraic or operative transformations; and the method of solution is the same.

The rule is most easily explained geometrically. Let $f(x)=0$ be the original equation. Write it in the form $f_2(x)=f_1(x)$, as may usually be done in many ways. Draw the curves $f_2(x)=y$ and $f_1(x)=y$. Then the roots of $f_2(x)=f_1(x)$ are evidently the abscissæ of the points of intersection of the two curves. The procedure adopted above is really as follows. Select any point, x_1, on the axis of x, and draw a straight line from it parallel to the axis of y, either in the positive or in the negative direction, until it meets the *nearer* of the two curves—let us say $f_1(x)=y$. From this second point draw a line parallel to y until it meets $f_2(x)=y$. From the third point draw a line parallel to x until it meets $f_1(x)=y$ again, and from the fourth point one parallel to y until it meets $f_2(x)=y$ again, and so on. Then the abscissa of the first and second points is x_1, of the third and fourth points is x_2, of the fifth and sixth points is x_3, and so on, and x_n must generally approach nearer and nearer to the point of intersection of the two curves—that is, to a root of the original equation.

Fig. 1 represents an intersection where the lines drawn according to the rule all lie within the angles formed by the converging curves. In this case, analytically, x_1, x_2, x_3, ..., are all either greater or all less than x, the abscissa of the point of intersection, although they constantly approach it. Fig. 2 illustrates the case where the lines ultimately approach the intersection spirally. Here, analytically, x_1, x_2, x_3 . . . alternately oscillate above and below x, although they constantly approach it. The former, or "staircase" procession, occurs while the differential coefficients of the two curves have the same sign; the latter, or alternating "spiral" procession, while they are of opposite signs.

The staircase procession trends in the same direction as the tangent vectors of the curves if x_2-x_1 is positive, and in the opposite direction if x_2-x_1 is negative. A similar law holds for the direction of rotation of the spiral procession. Thus x_1, x_2, x_3 . . . will increase or decrease, either continuously or alternately, according to whether we have taken x_1 on one or the other of the two curves